

Application Serial No. 10/658,301
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Listing of the Claims:

1. (Currently Amended) An apparatus for controlling an impact/pulse tool during a fastener tightening cycle comprising:

an inlet port for receiving a supply of pressurized fluid;

a fluid pressure regulator for maintaining a selectable pressure value to be delivered to the tool to be controlled in response to a control signal;

a sensor for measuring a characteristic corresponding to flow of the fluid to the tool to be controlled and for generating an output signal, wherein the characteristic corresponding to flow is at least one of differential pressure and acoustic data; and

a central processing unit for receiving the output signal from the sensor and for generating the control signal to be sent to the pressure regulator in response to the output signal from the sensor validating a fastener tightening cycle process based solely on a monitored signature of fluid flow versus time in accordance with a program stored in memory to control flow of fluid to the tool to be controlled.

2. (Original) The apparatus of claim 1, wherein the program further comprises a setup process for each fastener tightening cycle to be learned.

3. (Original) The apparatus of claim 2, wherein the setup process further comprises:

a transducer connectible between the tool to be controlled and the fastener to be tightened for generating a torque signal during a ramped pressure fastener tightening cycle; and

the central processing unit for receiving the torque signal from the transducer during the ramped pressure fastener tightening cycle, and for setting a fixed pressure value based on the received torque signal.

4. (Original) The apparatus of claim 2, wherein the setup process further comprises:

the central processing unit for receiving a torque value input by an operator using a manual torque wrench during a preset pressure fastener tightening cycle, and for setting a fixed pressure value based on the torque value input.

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5. (Original) The apparatus of claim 2, wherein the setup process further comprises:

a transducer connectible between the tool to be controlled and the fastener to be tightened for generating a torque signal during the fastener tightening cycle at a fixed pressure value; and

the central processing unit for receiving the torque signal from the transducer during the fastener tightening cycle at a fixed pressure value, and for setting a fluid flow signature based on the output signal received from the sensor and the received torque signal.

6. (Original) The apparatus of claim 2, wherein the setup process further comprises:

the central processing unit for receiving the output signal from the sensor during a free air run process, and for setting a threshold value based on the received output signal.

7. (Original) The apparatus of claim 2, wherein the setup process further comprises:

the central processing unit for receiving the output signal from the sensor during a tightened fastener rehit cycle, and for setting a threshold value based on the received output signal.

8. (Original) The apparatus of claim 2, wherein the program further comprises a control program for each fastener tightening cycle to be performed.

9. (Original) The apparatus of claim 8, wherein the control program further comprises:

the central processing unit for receiving the output signal from the sensor during the fastener tightening cycle, and for comparing the output signal with bench marks stored in memory based on a previous fluid flow signature of an acceptable fastener tightening cycle for controlling fluid flow to the tool to be controlled.

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10. (Original) The apparatus of claim 1, wherein the program further comprises an error proofing program for each fastener tightening cycle to be performed.

11. (Original) The apparatus of claim 10, wherein the error proofing program further comprises:

the central processing unit for receiving the output signal from the sensor during the fastener tightening cycle, and for comparing the output signal with bench marks stored in memory based on a previous fluid flow signature of an acceptable fastener tightening cycle for generating error proofing signals for the fastener tightening cycle based on the received output signal.

12. (Original) The apparatus of claim 1 further comprising:
an output port for supplying controlled fluid flow to the tool to be controlled through a standard fluid flow supply hose.

13. (Cancelled).

14. (Original) The apparatus of claim 1, wherein the pressurized fluid is compressed air.

15. (Currently Amended) The apparatus of claim 1 further comprising:

the sensor including at least one internal fluid flow metering device;

and

a switch operably connected to the central processing unit for running in a reverse cycle remote mode by electronically bypassing all internal fluid flow metering devices for reverse cycle operation.

16. (Original) The apparatus of claim 1 further comprising:

a transducer connectible between the tool to be controlled and the fastener to be tightened and operably connectible to the central processing unit for running a setup process for a fastener tightening cycle to be learned.

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17. (Currently Amended) A method for controlling an impact/pulse tool during a fastener tightening cycle comprising the steps of:
receiving a supply of pressurized fluid through an inlet port;
maintaining a selectable pressure value to be delivered to the tool to be controlled in response to a control signal with a fluid pressure regulator;
measuring a characteristic corresponding to flow of the fluid to the tool to be controlled with a sensor and generating an output signal, wherein the characteristic corresponding to flow is at least one of differential pressure and acoustic data; and
receiving the output signal from the sensor with a central processing unit and generating the control signal to be sent to the pressure regulator in response to the output signal from the sensor validating a fastener tightening cycle process based solely on a monitored signature of fluid flow versus time in accordance with a program stored in memory to control flow of fluid to the tool to be controlled.

18. (Original) The method of claim 17, wherein the program further comprises the step of running a setup process for each fastener tightening cycle to be learned.

19. (Original) The method of claim 18, wherein the setup process further comprises the steps of:
connecting a transducer between the tool to be controlled and the fastener to be tightened;
generating a torque signal during a ramped pressure fastener tightening cycle;
receiving the torque signal from the transducer with the central processing unit during the ramped pressure fastener tightening cycle; and
setting a fixed pressure value based on the received torque signal.

20. (Original) The method of claim 18, wherein the setup process further comprises the steps of:
receiving a torque value input by an operator using a manual torque wrench with the central processing unit during a preset pressure fastener tightening cycle; and
setting a fixed pressure value based on the torque value input.

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21. (Original) The method of claim 18, wherein the setup process further comprises the steps of:

- connecting a transducer between the tool to be controlled and the fastener to be tightened;
- generating a torque signal during the fastener tightening cycle at a fixed pressure value; and
- receiving the torque signal from the transducer with the central processing unit during the fastener tightening cycle at a fixed pressure value; and
- setting a fluid flow signature based on the output signal received from the sensor and the received torque signal.

22. (Original) The method of claim 18, wherein the setup process further comprises the steps of:

- receiving the output signal from the sensor during a free air run process with the central processing unit; and
- setting a threshold value based on the received output signal.

23. (Original) The method of claim 18, wherein the setup process further comprises the steps of:

- receiving the output signal from the sensor during a tightened fastener rehit cycle with the central processing unit; and
- setting a threshold value based on the received output signal.

24. (Original) The method of claim 18, wherein the program further comprises the step of running a control program for each fastener tightening cycle to be performed.

25. (Original) The method of claim 24, wherein the control program further comprises the steps of:

- receiving the output signal from the sensor during the fastener tightening cycle with the central processing unit;
- comparing the output signal with bench marks stored in memory based on a previous fluid flow signature of an acceptable fastener tightening cycle; and
- controlling fluid flow to the tool to be controlled based on results of the comparing step.

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26. (Original) The method of claim 17, wherein the program further comprises the step of running an error proofing program for each fastener tightening cycle to be performed.

27. (Original) The method of claim 26, wherein the error proofing program further comprises the steps of:

receiving the output signal from the sensor during the fastener tightening cycle with the central processing unit;
comparing the output signal with bench marks stored in memory based on a previous fluid flow signature of an acceptable fastener tightening cycle; and
generating error proofing signals for the fastener tightening cycle based on the received output signal.

28. (Original) The method of claim 17 further comprising the step of:
supplying controlled fluid flow to the tool to be controlled through an output port and a standard fluid flow supply hose.

29. (Cancelled).

30. (Original) The method of claim 17, wherein the pressurized fluid is compressed air.

31. (Currently Amended) The method of claim 17 further comprising the step of:

metering flow of fluid with the sensor including at least one internal fluid flow metering device; and

operably connecting a switch to the central processing unit for running in a reverse cycle remote mode by electronically bypassing all internal fluid flow metering devices for reverse cycle operation.

32. (Original) The method of claim 17 further comprising the step of:
operably connecting a transducer between the tool to be controlled and the fastener to be tightened; and

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operably connecting an torque signal from the transducer to the central processing unit for running a setup process for a fastener tightening cycle to be learned.

33. (Currently Amended) An apparatus for controlling an impact/pulse tool during a fastener tightening cycle comprising:
a port connectible to a supply of pressure regulated fluid;
a sensor for sensing a characteristic corresponding to flow of fluid to the tool to be controlled and for generating an output signal, wherein the characteristic corresponding to flow is at least one of differential pressure and acoustic data; and
a central processing unit for processing the received output signal from the sensor to validate a fastener tightening cycle process and control flow of fluid to the tool to be controlled without reference to an actual amount of torque applied to the fastener.

34. (Currently Amended) An apparatus for controlling an impact/pulse tool during a fastener tightening cycle comprising:
a port connectible to a supply of pressurized fluid regulated to a constant pressure;
means for monitoring a characteristic corresponding to flow of fluid to the tool to be controlled at the regulated constant fluid pressure; and
means for analyzing the monitored characteristic to determine tool fastener tightening cycle process validity without reference to an actual amount of torque applied to the fastener.

35. (Previously Presented) The apparatus of claim 34, wherein the processing means further comprises means for comparing the monitored characteristic as a monitored fluid flow signature versus time to an acceptable fluid flow signature versus time.

36. (Previously Presented) The apparatus of claim 34, wherein the characteristic corresponding to flow of fluid is at least one of differential pressure and acoustic data.

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37. (Currently Amended) In an apparatus for controlling an impact/pulse tool during a fastener tightening cycle, the tool connectible to a supply of fluid regulated to a constant pressure, the improvement comprising:

means for monitoring a characteristic corresponding to a fluid flow signature over a predetermined period of time for fluid supplied to the tool to be controlled; and

means for determining tool process validity based solely on the monitored fluid flow signature versus time.

38. (Previously Presented) The apparatus of claim 37, wherein the determining means further comprises means for comparing the monitored fluid flow signature versus time to an acceptable fluid flow signature versus time to determine tool process validity.

39. (Previously Presented) The apparatus of claim 37, wherein the characteristic corresponding to fluid flow signature is at least one of differential pressure and acoustic data.

40. (Currently Amended) The apparatus of claim 37 further In an apparatus for controlling an impact/pulse tool during a fastener tightening cycle, the tool connectible to a supply of fluid regulated to a constant pressure, the improvement comprising:

means for monitoring a characteristic corresponding to a fluid flow signature over a predetermined period of time for fluid supplied to the tool to be controlled, the monitoring means including at least one internal fluid flow metering device;

means for determining tool process validity based solely on the monitored fluid flow signature versus time; and

a switch operably connected to the central processing unit for running in a reverse cycle remote mode by electronically bypassing all internal fluid flow metering devices for reverse cycle operation.

41. (New) The apparatus of claim 1, wherein the characteristic corresponding to flow is at least one of differential pressure and acoustic data.

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42. (New) The apparatus of claim 1, wherein the central processing unit determines whether a fastener tightening cycle process is one of a valid process cycle and an invalid process cycle.

43. (New) The apparatus of claim 42, wherein if an invalid process cycle occurs, the central processing unit determines whether the fastener tightening cycle process is invalid as a result of one of a rehit fastener cycle, a slipping fastener cycle, and an early trigger release fastener cycle.

44. (New) The method of claim 17, wherein the characteristic corresponding to flow is at least one of differential pressure and acoustic data.

45. (New) The method of claim 17, wherein the central processing unit determining step further comprises the step of determining whether a fastener tightening cycle process is one of a valid process cycle and an invalid process cycle.

46. (New) The method of claim 45, wherein if an invalid process cycle occurs, the central processing unit determining step further comprises the step of determining whether the fastener tightening cycle process is invalid as a result of one of a rehit fastener cycle, a slipping/stripping fastener cycle, and an early trigger release fastener cycle.

47. (New) The apparatus of claim 33 further comprising:
the central processing unit validating a fastener tightening cycle process based solely on a monitored signature of fluid flow versus time.

48. (New) The apparatus of claim 34 further comprising:
the analyzing means to determine fastener tightening cycle process validity based solely on a monitored signature of fluid flow versus time.